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(54) WATER-BASED CUTTING FLUID

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an aqueous cutting fluid that can be readily disposed as general sewage.
SOLUTION: The aqueous cutting fluid according to this invention is basically prepared by dispersing the abrasive grains into an aqueous solution including an emulsifier for food products and food additives. The emulsifier for food products used here is a kind of food additives without adverse effect to human bodies and can be disposed as general sewage by removing the abrasive grains and the chips from the dispersion after use.

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(54)【発明の名称】　水性切削液

(57)【要約】
【課題】本発明は、一般排水として処理が容易な水性切削液を提供することを目的とする。
【解決手段】本発明に係る水性切削剤は、食品用乳化剤と食品添加物を主とする補助剤とを含有した水性液に砥粒を分散させたものを基本構成とする。食品用乳化剤は食品添加物であり、人体に悪影響も無いことから、使用後に砥粒や切粉を除去することにより、一般排水としての廃水処理ができる。

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【特許請求の範囲】

【請求項１】食品用乳化剤と、食品添加剤を主とする補助剤とを含有する水性液に、砥粒を分散させたことを特徴とする水性切削液。

【請求項２】前記補助剤が、増粘剤、湿潤剤、消泡剤及び防錆剤であることを特徴とする請求項１記載の水性切削液。

【請求項３】前記水性切削液のｐＨが７～８であることを特徴とする請求項１又は２記載の水性切削液。

【請求項４】前記食品用乳化剤がＨＬＢの値が異なる２種以上の食品用乳化剤であることを特徴とする請求項１記載の水性切削液。

【請求項５】前記増粘剤がカルボキシルメチルセルロースナトリウム（ＣＭＣ）であることを特徴とする請求項２記載の水性切削液。

【請求項６】前記保湿剤が食添用グリセリン又はＤ－ソルビートル液のうちから選択される少なくとも１の食品用湿潤剤であることを特徴とする請求項２記載の水性切削液。

【請求項７】前記防錆剤がカルボン酸を配合した防錆剤であることを特徴とする請求項２記載の水性切削液。

【請求項８】前記消泡剤が食品用シリコーン消泡剤であることを特徴とする請求項２記載の水性切削液。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、例えば、ワイヤーソー等の加工装置において使用される水性切削液に関するものである。

【０００２】

【従来の技術】半導体用シリコンインゴット、セラミック、ガラスなどの硬脆材料からなるワークを切断する加工装置としてワイヤーソーがある。このワイヤーソーは、所定のテンションに張設された多数本のワイヤーをワークに押付け、それらワイヤーを往復運転させながら、砥粒の研磨作用によりワークを切断するものである。

【０００３】このワイヤーソーによる切削加工時に使用される砥粒は、ワイヤーに固着される場合（固定砥粒方式）もあるが、液に砥粒を分散させた切削液を使用する場合（遊離砥粒方式）が多い。この遊離砥粒方式では、通常、流動性を調整しやすい点から、研磨剤を懸濁する切削液には、主に鉱物油を主成分とする油性切削液が使用され、非加工物の切断に使用された後の切削液は、産業廃棄物として処理されている。また、切断加工後の被加工物の洗浄用として有機溶剤系の洗浄液が使用されている。

【０００４】

【発明が解決しようとする課題】油性切削液や有機溶剤系の洗浄剤は、廃棄処分が厄介である。また、油性切削液は、切削液の主成分が鉱物油であるため引火の可能性

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が全くないとは言えない。また、切削中に飛散した切削液による加工装置の汚れが激しく、オイルミストによる悪臭及び直接皮膚に付着するとかゆみなどの症状が起こり等、人体への悪影響が懸念される。また、被加工物の洗浄液も有機溶剤系のものを使用するが、大気汚染の主原因となることから、使用規制がなされつつあるという問題があった。

【０００５】そこで、本発明は、一般排水として処理することが可能で、また上述した不都合のない水性切削液を提供することを目的とする。

【０００６】

【課題を解決するための手段】本発明に係る水性切削液は、食品用乳化剤と食品添加物を主とする補助剤とを含有する水性液に、砥粒を分散させたものである。補助剤は、例えば、増粘剤、湿潤剤、消泡剤及び防錆剤であり、食品添加剤を主体とする。また、水性切削液は、一般排水として処理することを可能にするために、また、被切削物がシリコンである場合にゲル化を防止するために、ｐＨが７～８であることが好ましい。

【０００７】また、食品用乳化剤としては、グリセリン脂肪酸エステル、ショ糖脂肪酸エステル、プロピレングリコール脂肪酸エステル、レシチンがある。その中でも耐熱性、耐酸性及び耐塩性に優れたポリグリセリン脂肪酸エステルが好適である。また、食品用乳化剤は、ＨＬＢの値が異なる２種以上の食品用乳化剤を含有することが好適である。

【０００８】また、増粘剤としては、動物性増粘剤（カゼイン、ゼラチン、グルテン等），植物性増粘剤（アルギン酸ナトリウム、キサンタンガム、タマリンドガム等），アクリル酸系増粘剤（ポリアクリル酸ナトリウム等），繊維素誘導体（カルボキシルメチルセルロースナトリウム（以下、「CMC」という。），メチルセルロース等）があるが、その中でも薬品・熱・光に安定で増粘効果が大きいCMCが好適である。

【０００９】また、保湿剤としては、グリセリン、プロピレングリコール、乳酸ナトリウム、ソルビトール、キシリトール、還元澱粉加水分解物（還元水あめ等）があるが、その中でも保湿性に優れた食添用グリセリンとD-ソルビトール液が好適である。

【００１０】また、防錆剤はカルボン酸を配合したものが好ましい。

【００１１】また、消泡剤としては、脂肪酸エステル系（グリセリン脂肪酸エステル等），シリコーン系（シリコーンオイル等）があるが、その中でも食品用シリコーン消泡剤が好適である。

【００１２】

【発明の実施の形態】以下、本発明に係る水性切削液の実施形態を説明する。なお、以下の実施形態では、遊離砥粒方式による加工装置、例えばワイヤーソーに適用した場合について説明するが、本発明に係る水性切削液

は、ワイヤーソー用に限定されることなく、例えば、ラッピング装置やポリシング装置等の他の加工装置にも適用可能である。

【００１３】本実施形態に係る水性切削液は、蒸留水やイオン交換水などに食品用乳化剤を主剤として含有させた水性液に砥粒を分散させたものを基本構成とする。また、水性切削液は、増粘剤、湿潤剤、消泡剤及び防錆剤を補助剤として含有させている。

【００１４】この水性切削液は、食品用乳化剤などの食品添加剤を添加させた水性液を用いているので一般排水として処理することが可能である。また、水性であり引火性の物質を含有しないから引火などのおそれがない。また、無害の食品添加物を含有させた水性液を用いているので、人体への悪影響などもほとんどない。また、水性であるため、衣服への付着やワイヤー等の加工装置に付着した場合も簡単に洗い落とすことができ、砥粒のリサイクルも容易である。

【００１５】以下、水性切削液の含有させる①食品用乳化剤、②増粘剤、③湿潤剤、④防錆剤、⑤消泡剤の各添加物について詳述する。

【００１６】①食品用乳化剤は、通常の食品用の乳化剤である。ここで用いられる食品用乳化剤としては、グリセリン脂肪酸エステル、ショ糖脂肪酸エステル、プロピレングリコール脂肪酸エステル、レシチンがある。その中でも耐熱性、耐酸性及び耐塩性に優れたポリグリセリン脂肪酸エステルが好適である。

【００１７】食品用乳化剤は、HLBの違う２種類のものを使用することが好ましい。ここで、「HLB」は、Hydrophile Lyophile Balanceを略記したものであり、分子中に含まれる親水性と親油性のバランスを特性値として利用した指標的数値である。すなわち、HLBが高いほど親水性であり、HLBが低いほど親油性である。

【００１８】低HLBタイプの食品用乳化剤は、親油性の性質をより強く備えることから被加工物に界面膜を形成し、被加工物と切断部材（例えば、ワイヤーソーにおけるワイヤー）との潤滑性を確保する働きがある。また、その界面膜により、被加工物の酸化防止も行なう。低HLBタイプの食品用乳化剤は、低HLB値が低い方がより親油性であり、潤滑性及び酸化防止効果の向上が期待でき、特にHLB値が１～８であるものが好適である。

【００１９】高HLBタイプの食品用乳化剤は、低HLB食品用乳化剤の乳化分散を助ける働きがある。また、表面張力低下による切断部分への液浸透性向上の働きもある。高HLBタイプの食品用乳化剤は、HLB値が高い方がより親水性であり、表面張力低下能が高くなるので、特にHLB値が１１～１６であるものが好適である。

【００２０】低HLBタイプの食品用乳化剤の添加量は、多いほど良いがコスト高となるため０．１～３．０重量％が適量である。高HLBタイプの食品用乳化剤の添加量は、多すぎると発泡の原因となるため、出来る限り少量の添加量で良く、０．０５～１．５０重量％が適量である。

【００２１】高HLBタイプの食品用乳化剤と低HLBタイプの食品用乳化剤との両方とも、表面張力低下能があり、切削液の表面張力によるワイヤー同士の引き付け合いが防止できる。また、高HLBタイプの食品用乳化剤と低HLBタイプの食品用乳化剤の両方とも、切削液に懸濁する研磨材表面の改質が行え、高濃度に添加すると分散剤としての働きもある。

【００２２】②増粘剤は、生理的に無害な食品用増粘剤を使用する。食品用増粘剤としては、動物性増粘剤（カゼイン、ゼラチン、グルテン等），植物性増粘剤（アルギン酸ナトリウム、キサンタンガム、タマリンドガム等），アクリル酸系増粘剤（ポリアクリル酸ナトリウム等），繊維素誘導体（CMC，メチルセルロース等）があるが、その中でも薬品・熱・光に安定で増粘効果が大きいCMCが好適である。

【００２３】CMCは、増粘作用及び乳化分散作用により、切削液に懸濁する研磨材の分散安定・沈降防止が行える。

【００２４】増粘剤は、切断時に発生する局部的な高熱及び切断部での機械的ダメージにより、極めて僅かに粘度が低下する傾向があり、これにより切断時に発生する切粉混入による切削液の増粘を緩和することができる。

【００２５】③湿潤剤は、人体に無害な食品用保湿材が使用される。食品用保湿剤としては、グリセリン、プロピレングリコール、乳酸ナトリウム、ソルビトール、キシリトール、還元澱粉加水分解物（還元水あめ等）があるが、その中でも保湿性に優れた食添用グリセリンとD－ソルビトール液が好適である。

【００２６】食添用グリセリンの添加量を増やすことにより、保湿性向上及び切削量向上が図られるが、切削負荷が高くなるため１０～３０重量％が好適である。

【００２７】D－ソルビトール液は、添加量が１０重量％以下の場合、水分蒸発防止効果が極端に悪くなるため１０～３０重量％が好適である。

【００２８】④防錆剤は、被加工物がシリコンで切削液のpHが高い場合、切削により発生するシリコンの切粉が切削液に混入すると化学反応が生じ、切削液がゲル化する可能性があるため、pH８以下の物が適切である。また、発泡性の低いものが良い。カルボン酸を配合した防錆剤を使用すると、切削時の切削液のpH変化をpH８以下に調整することができるため、上記ゲル化を防止できて好適である。防錆剤の添加量は、少ないと防錆効果が低下し、多いコスト高となるため、０．２５～０．５重量％が好適である。

【００２９】⑤消泡剤は、人体に無害で、安全性が高く、耐熱性が良い食品用消泡剤を使用することが好ましい。食品用消泡剤としては、脂肪酸エステル系（グリセリン脂肪酸エステル等），シリコーン系（シリコーンオ

イル等）があるが、その中でも食品用シリコーン消泡剤が好適である。　食品用シリコーン消泡剤は、強い消泡効果を有するので、極微量の添加で充分な効果がある。また、他の消泡剤に比べて持続性もある。消泡剤の添加量は、多いと切断部材への付着性が悪くなるため、０．１～０．５重量％が適量である。

【００３０】以下、本発明に係る水性切削液について各添加物の配合比を変えた実施例の性能を、従来品の油性切削液の性能と比較する。

【００３１】第１実施例の水性切削液は、後記表１の上段に示すように、低HLBタイプの食品用乳化剤としてのショ糖脂肪酸エステル（HLB＝５）：１．８重量％，高HLBタイプの食品用乳化剤としてのポリグリセリン脂肪酸エステル（HLB＝１６）：０．９重量％，食品用増粘剤としてのＣＭＣ：０．９重量％，食品用湿潤剤としてのグリセリン：８．７重量％，蒸留水：８７．７重量％とを混合した水溶液１６２Ｌに、砥粒（GC#800）：１６０Ｋｇ，消泡剤：０．９Ｌ，防錆剤：１．８Ｌを添加したものである。

【００３２】第２実施例の水性切削液は、後記表１の下段に示すように、低HLBタイプの食品用乳化剤としてのポリグリセリン脂肪酸エステル（HLB＝７）：０．０８重量％，高HLBタイプの食品用乳化剤としてのポリグリセリン脂肪酸エステル（HLB＝１５）：０．０４重量％，食品用増粘剤としてのＣＭＣ：１．４８重量％，食品用湿潤剤としてのグリセリン：１６．４重量％，蒸留水：８２．０重量％とを混合した水溶液１６２Ｌに、砥粒（GC#800）：１６０Ｋｇ，消泡剤：０．９Ｌ，防錆剤：１．８Ｌを添加したものである。

【００３３】第３実施例の水溶液は、後記表２の上段に示すように、低HLBタイプの食品用乳化剤としてのポリグリセリン脂肪酸エステル（HLB＝７）：２．７１重量％，高HLBタイプの食品用乳化剤としてのポリグリセリン脂肪酸エステル（HLB＝１５）：０．２７重量％，食品用増粘剤としてのＣＭＣ：１．０９重量％，食品用湿潤剤としてのグリセリン：２０．０５重量％とD－ソルビトール液：２１．６８重量％，蒸留水：５４．２重量％とを混合した水溶液１６２Ｌに、砥粒（GC#800）：１６０Ｋｇ，消泡剤：０．９Ｌ，防錆剤：１．８Ｌを添加したものである。

【００３４】なお、後記表２の下段に示すものは、従来例の油性切削液で、ラッピングオイル１４０Ｌに砥粒１８０Ｋｇを添加したものである。

【００３５】表１、表２中、各実施例の粘度、pH、表面張力、密度の各欄の数値は、それぞれ実測値である。なお、その他の欄については以下の通り評価した。

【００３６】「泡」の欄は、１００ｍＬサンプル瓶に８０ｍＬ程度注入した液を１分間人力揺動させ、１５分間放置後の泡の高さを測定した測定値である。また、液は砥粒を入れない状態で測定した。

【００３７】「砥粒分散性」の欄は、１００ｍＬサンプル瓶に８０ｍＬ程度注入した液を２４時間放置した後、沈降した砥粒の状態を確認した評価である。なお、評価基準は、凝固していないものを○、少し凝固しかけているものを△、凝固しているものを×とした。

【００３８】「水分蒸発」の欄は、３０ｍＬの切削液をシャーレに入れ、恒温器で５０℃４時間加熱し、加熱前と加熱後の重量差が全て水分蒸発量であると想定して、下記の計算式から水分蒸発率（％）を算出した数値を示す。なお、この試験は、砥粒を入れた切削液で行った。

水分蒸発率（％）＝｛（加熱前重量－加熱後重量）／加熱前重量｝×１００

【００３９】「ウエハー乾燥模擬」の欄は、スライス後のウエハーに切削液を定量（２ｍＬ程度）吹き掛けた後、５０℃に維持した恒温器で４時間加熱した後、ウエハーに付着している切削液の乾燥状態を目視確認した評価である。なお、評価基準は、乾燥していないものを○、少し乾燥しかけているものを△、乾燥しているものを×とした。

【００４０】「洗浄性」の欄は、ウエハー乾燥模擬テストで加熱したウエハーを流水で洗浄し、簡単に洗浄できるか確認した評価である。なお、評価基準は、簡単に洗い落とせるものを○、洗い落とせないものを×とした。

【００４１】「ウエハー厚さのバラツキ」の欄は、実機によってシリコンインゴットをカットした結果得られた各シリコンウエハーの厚さのバラツキを測定した測定値である。

【００４２】また、実機カットの試験内容は、高さと幅がそれぞれ１５０mmで長さが３００mmの直方体のシリコンインゴットを、ワイヤーソーを用いて４個所同時に切断し、厚さ０．３５５mmのウエハーを切出すものである。

【００４３】この場合、ワイヤーソーに使用するワイヤーの線径は０．１８mmとする。また、スライス条件としては、ワイヤー送り速度を６００ｍ／ｍｉｎとし、ワイヤーテンションを２５Ｎとし、ワーク送り速度を０．３３mm／ｍｉｎとしたものである。

【００４４】上記試験結果によると、ウエハー厚さのばらつきは、油性切削剤を用いた場合が３５μｍ以下であるのに対し、本発明に係る水性切削液の各実施例は３０μｍ以下と略同程度以上の性能を備える。また、本発明に係る水性切削剤の各実施例は、洗浄性、ウエハー乾燥模擬においては油性切削剤よりも優れており、砥粒の分散性においても油性切削剤と同程度以上の性能を備える。

【００４５】なお、表１、表２において、ＮＤの記号は当該欄についてデータがないことを示す。

【００４６】本発明に係る水性切削液が、水性であることから引火の危険性もなく、加工後の被加工物に付着した切削液も簡単に水で洗い流せることから油性切削剤よ

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りも有用である。また、本発明に係る水性切削液は、食品添加物を主成分としていることから、被加工物の切断に使用された後の切削液は、切削液中の砥粒や被加工物の切粉を回収すれば、既設排水設備で一般排水としての処理が可能であって、廃棄処理の問題もほとんどなくなる。

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＊【００４７】以上、本発明の実施形態に係る水性切削液について説明したが、本発明に係る水性切削液は上記のものに限定されず、例えば、各添加物の選択やその配合比について種々の変更が可能である。

【００４８】

【表１】

実施例	配合比	測定結果 粘度(25℃)(cp)	pH	表面張力(dyne/cm)	密度(kg/L)	泡(mm)	砥粒分散性	水分蒸発(%)	ウエハー乾燥模擬	洗浄性	実機カット結果 ウエハー厚さバラツキ(μm)
1	ショ糖脂肪酸エステル (HLB:5) :1.8wt% ポリグリセリン脂肪酸エステル (HLB:16) :0.9wt% CMC :0.9wt% グリセリン :8.7wt% 蒸留水 :87.7wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	90	8.2	31.5	1.54	12	○	ND	ND	ND	ND
2	ポリグリセリン脂肪酸エステル (HLB:7) :0.08wt% ポリグリセリン脂肪酸エステル (HLB:15) :0.04wt% CMC :1.48wt% グリセリン :16.4wt% 蒸留水 :82.0wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	160	8.3	28.3	1.55	3	△	27	△	○	30μm以下

【００４９】

【表２】

実施例	配合比	測定結果 粘度(25℃)(cp)	pH	表面張力(dyne/cm)	密度(kg/L)	泡(mm)	砥粒分散性	水分蒸発(%)	ウエハー乾燥模擬	洗浄性	実機カット結果 ウエハー厚さバラツキ(μm)
3	ポリグリセリン脂肪酸エステル (HLB:7) :2.71wt% ポリグリセリン脂肪酸エステル (HLB:15) :0.27wt% CMC :1.09wt% グリセリン :20.05wt% D-ソルビトール液 :21.68wt% 蒸留水 :54.2wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	360	7.5	27.2	1.59	1	○	25	○	○	30μm以下
従来	ラッピングオイル 140L 砥粒(GC#800) 160kg	80	—	26.3	1.5	ND	△	—	○	×	35μm以下

【００５０】

【発明の効果】本発明に係る水性切削液は、食品用乳化剤と食品添加剤を主とする補助剤とを含有する水性液に、砥粒を分散させたので、引火などの危険性が全くない。また、食品乳化剤及び補助剤は食品添加剤を主体とするので、悪臭や人体への悪影響なども無く、使用後の処理についても砥粒と切粉を分離除去すれば一般排水としての処理が容易に行える。

【００５１】前記補助剤が、増粘剤、湿潤剤、消泡剤及び防錆剤であるので、増粘剤は、砥粒の分散を安定さ

せ、砥粒の沈降を防止させるものである。また、湿潤剤は、水分蒸発を防止する効果がある。また、消泡剤は、ワイヤーソーにおけるワイヤーなど切断部材への付着性を良くする効果がある。また、防錆剤は、被加工物の加工面の防錆効果が期待できる。

【００５２】また、水性切削液のｐＨが７～８であるものは、被切削液がシリコンである場合に、シリコンの切粉が混入した場合でも切削液のゲル化を防止できる。

【００５３】前記食品用乳化剤として、ＨＬＢの値が異なる２種以上の食品用乳化剤を含有する水性切削剤は、低ＨＬＢタイプの食品用乳化剤の親油性により、潤滑性と酸化防止効果の向上が期待できる。高ＨＬＢタイプの食品用乳化剤は、低ＨＬＢタイプの食品用乳化剤の乳化分散を助ける働きがあり、また、表面張力低下による切断部分への切削液の浸透性を向上させる作用もある。

【００５４】また、食品用増粘剤としてカルボキシルメチルセルロースナトリウム（ＣＭＣ）が使用されている水性切削剤は、ＣＭＣが薬品・熱・光に安定で増粘効果も大きいことから、増粘作用，乳化分散作用が安定して発揮されて、切削液に懸濁する砥粒の分散安定・沈降防止がより期待できる。

【００５５】また、食品用保湿剤として食添用グリセリンが使用されている水性切削液は、より高い保湿性が得られる。また、食品用保湿剤としてＤ－ソルビートル液が使用されている水性切削液は、Ｄ－ソルビトール液が、金属イオンと反応し、キレートを作る機能を持っているため、金属イオンによる酸化を防止する効果がある。

【００５６】また、防錆剤がカルボン酸を配合した防錆剤である水性切削液は、被加工物がシリコンである場合に、シリコンの切粉が切削液に混入しても、カルボン酸によりpHが７～８に調整されるので、切削液のゲル化が防止される。

【００５７】また、消泡剤として、食品用シリコーン消泡剤が使用されている水性切削液は、食品用シリコーンが他の消泡剤に比べ強い消泡効果を持つため、添加量が少なくて済む。

フロントページの続き

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] Aquosity cutting fluid characterized by making the aquosity liquid containing a food-grade emulsifier and the adjuvant which is mainly concerned with a food additive distribute an abrasive grain.
[Claim 2] Aquosity cutting fluid according to claim 1 with which said adjuvant is characterized by being a thickener, a wetting agent, a defoaming agent, and a rusr-proofer.
[Claim 3] Aquosity cutting fluid according to claim 1 or 2 characterized by pH of said aquosity cutting fluid being 7-8.
[Claim 4] Aquosity cutting fluid according to claim 1 characterized by said food-grade emulsifiers being two or more sorts of food-grade emulsifiers with which the values of HLB differ.
[Claim 5] Aquosity cutting fluid according to claim 2 characterized by said thickener being the sodium carboxymethyl cellulose (CMC).
[Claim 6] Aquosity cutting fluid according to claim 2 characterized by said moisturizer being a food-grade wetting agent of at least 1 chosen from from among the glycerol for food additives, or D-Sol Beetle liquid.
[Claim 7] Aquosity cutting fluid according to claim 2 characterized by being the rusr-proofer with which said rusr-proofer blended the carboxylic acid.
[Claim 8] Aquosity cutting fluid according to claim 2 characterized by said defoaming agent being a food-grade silicone defoaming agent.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the aquosity cutting fluid used in processing equipments, such as a wire saw.
[0002]
[Description of the Prior Art] There is a wire saw as processing equipment which cuts the work piece which consists of hard and brittle materials, such as a silicon ingot for semi-conductors, a ceramic, and glass. This wire saw cuts a work piece by scouring of an abrasive grain, forcing on a work piece the wire of the a large number book stretched by the predetermined tension, and carrying out both-way operation of these wires.
[0003] Although the abrasive grain used at the time of cutting by this wire saw may fix on a wire (bonded abrasive method), the cutting fluid which made liquid distribute an abrasive grain is used for it in many cases (loose grain method). By this loose grain method, cutting fluid after the oily cutting fluid which mainly uses straight mineral oil as a principal component was used for the cutting fluid which suspends an abrasive material and usually being used for cutting of a non-processed object from the point of being easy to adjust a fluidity is processed as industrial waste. Moreover, the penetrant remover of an organic solvent system is used as an object for washing of the workpiece after cutting processing.
[0004]
[Problem(s) to be Solved by the Invention] Oily cutting fluid and the cleaning agent of an organic solvent system have troublesome disposal. Moreover, it cannot be said that oily cutting fluid does not have the possibility of ignition since the principal component of cutting fluid is straight mineral oil. Moreover, the dirt of the processing equipment by the cutting fluid which dispersed during cutting is intense, and we adhere to the offensive odor and the direct skin by the oil mist, or are [Yumi's etc. symptom] anxious about the

bad influence to the bodies, such as a cause. Moreover, although the penetrant remover of a workpiece also used the thing of an organic solvent system, since it became the cause of main of air pollution, there was a problem that use regulation was being made.
[0005] Then, processing as common wastewater is possible, and this invention aims at offering the inconvenient aquosity cutting fluid which was mentioned above and which is not.
[0006]
[Means for Solving the Problem] The aquosity cutting fluid concerning this invention makes the aquosity liquid containing the adjuvant which is mainly concerned with a food-grade emulsifier and a food additive distribute an abrasive grain. Adjuvants are a thickener, a wetting agent, a defoaming agent, and a rusr-proofer, and make a food additive a subject. Moreover, in order to make it possible to process as common wastewater, and in order to prevent gelation when a cut object is silicon, as for aquosity cutting fluid, it is desirable that pH is 7-8.
[0007] Moreover, as a food-grade emulsifier, there are a glycerine fatty acid ester, sucrose fatty acid ester, propylene glycol fatty acid ester, and lecithin. The polyglyceryl fatty acid ester which was excellent in thermal resistance, acid resistance, and the salt atmosphere also in it is suitable. Moreover, it is suitable for a food-grade emulsifier to contain two or more sorts of food-grade emulsifiers with which the values of HLB differ.
[0008] Moreover, as a thickener, although there are animal thickeners (casein, gelatin, gluten, etc.), vegetable thickeners (sodium alginate, xanthan gum, tamarind gum, etc.), acrylic-acid system thickeners (sodium polyacrylate etc.), and fibrin derivatives (sodium carboxymethyl cellulose (henceforth "CMC"), methyl cellulose, etc.), also in it, it is stable in a chemical, heat, and light, and CMC with the large thickening effectiveness is suitable for it.
[0009] Moreover, as a moisturizer, although there are a glycerol, propylene glycol, sodium lactate, a sorbitol, xylitol, and reduction amylolysis objects (restoration water candy etc.), the glycerol for food additives and D sorbitol liquid which were excellent in moistness also in it are suitable.
[0010] Moreover, as for a rusr-proofer, what blended the carboxylic acid is desirable.
[0011] Moreover, as a defoaming agent, although there are fatty-acid-ester systems (glycerine fatty acid ester etc.) and silicone systems (silicone oil etc.), a food-grade silicone defoaming agent is suitable also in it.
[0012]
[Embodiment of the Invention] Hereafter, the operation gestalt of the aquosity cutting fluid concerning this invention is explained. In addition, although the following operation gestalten explain the case where it applies to the processing equipment by the loose grain method, for example, a wire saw, the aquosity cutting fluid concerning this invention can

be applied to other processing equipments, such as wrapping equipment and polishing equipment, for example, without being limited to wire saws.
[0013] The aquosity cutting fluid concerning this operation gestalt considers the thing which made the aquosity liquid which made distilled water, ion exchange water, etc. contain a food-grade emulsifier as base resin distribute an abrasive grain as a basic configuration. Moreover, aquosity cutting fluid is making the thickener, the wetting agent, the defoaming agent, and the rusr-proofer contain as an adjuvant.
[0014] Since the aquosity liquid which made food additives, such as a food-grade emulsifier, add is used for this aquosity cutting fluid, it can be processed as common wastewater. Moreover, it is aquosity, and since the inflammable matter is not contained, there is no fear, such as ignition. Moreover, since the aquosity liquid which made the harmless food additive contain is used, there is almost no bad influence to the body etc. Moreover, since it is aquosity, also when it adheres to processing equipments, such as adhesion on clothes, and a wire, it can wash out easily, and recycle of an abrasive grain is also easy.
[0015] Hereafter, each additive of ** food-grade emulsifier which aquosity cutting fluid makes contain, ** thickener, ** wetting agent, ** rusr-proofer, and ** defoaming agent is explained in full detail.
[0016] ** A food-grade emulsifier is an emulsifier of the usual food grade. As a food-grade emulsifier used here, there are a glycerine fatty acid ester, sucrose fatty acid ester, propylene glycol fatty acid ester, and lecithin. The polyglyceryl fatty acid ester which was excellent in thermal resistance, acid resistance, and the salt atmosphere also in it is suitable.
[0017] As for a food-grade emulsifier, it is desirable to use two kinds of things from which HLB is different. Here, "HLB" is the hydrophilic property which outlines Hydrophile Lyophile Balance and is included in a molecule, and the indexical numeric value which used oleophilic balance as a characteristic value. That is, it is a hydrophilic property, so that HLB is high, and it is oleophilic, so that HLB is low.
[0018] Since a low HLB type food-grade emulsifier is more strongly equipped with an oleophilic property, it forms the interface film in a workpiece, and it has the work which secures the lubricity of a workpiece and a cutting member (for example, wire in a wire saw). Moreover, the interface film also performs antioxidizing of a workpiece. The one where a low HLB value is lower is oleophilic more, a low HLB type food-grade emulsifier can expect improvement in lubricity and the antioxidizing effectiveness, and that especially whose HLB values are 1-8 is suitable for it.
[0019] A high HLB type food-grade emulsifier has the work which helps emulsification distribution of a low HLB food-grade emulsifier. Moreover, there is also work of the improvement in liquid permeability to the cutting part by surface tension fall. The thing

whose one where an HLB value is higher is a hydrophilic property more and especially whose HLB values are 11-16 since surface tension fall ability becomes high is suitable for a high HLB type food-grade emulsifier.

[0020] Although many additions of a low HLB type food-grade emulsifier are so good that there are, since they serve as cost quantity, 0.1 - 3.0 % of the weight is optimum dose. Since too many additions of a high HLB type food-grade emulsifier will cause foaming if there are, it is good at the little possible addition, and 0.05 - 1.50 % of the weight is optimum dose.

[0021] Both a high HLB type food-grade emulsifier and a low HLB type food-grade emulsifier have surface tension fall ability, and spasm **** of the wires by the surface tension of cutting fluid can be prevented. Moreover, when both a high HLB type food-grade emulsifier and a low HLB type food-grade emulsifier can perform reforming on the front face of abrasives suspended in cutting fluid and it is added to high concentration, there is also work as a dispersant.

[0022] ** A harmless food-grade thickener is physiologically used for a thickener. As a food-grade thickener, although there are animal thickeners (casein, gelatin, gluten, etc.), vegetable thickeners (sodium alginate, xanthan gum, tamarind gum, etc.), acrylic-acid system thickeners (sodium polyacrylate etc.), and fibrin derivatives (CMC, methyl cellulose, etc.), also in it, it is stable in a chemical, heat, and light, and CMC with the large thickening effectiveness is suitable for it.

[0023] CMC can perform distributed stability and sedimentation prevention of the abrasives suspended in cutting fluid according to a thickening operation and an emulsification distribution operation.

[0024] By the mechanical damage in the local high temperature and the local cutting section which are generated at the time of cutting, a thickener has the inclination for viscosity to fall very slightly, and can mitigate thickening of the cutting fluid by chip mixing which this generates at the time of cutting.

[0025] ** Food-grade moisturization material with a wetting agent harmless to the body is used. As a food-grade moisturizer, although there are a glycerol, propylene glycol, sodium lactate, a sorbitol, xylitol, and reduction amylolysis objects (restoration water candy etc.), the glycerol for food additives and D sorbitol liquid which were excellent in moistness also in it are suitable.

[0026] Although improvement in the amount of cutting on a moisturization disposition is achieved by increasing the addition of the glycerol for food additives, since a cutting load becomes high, 10 - 30 % of the weight is suitable.

[0027] When an addition is 10 or less % of the weight, since the moisture antiflashing effectiveness gets extremely bad, 10 - 30 % of the weight is suitable for D sorbitol liquid.

[0028] ** Since a chemical reaction arises and cutting fluid may gel a rusr-proofer if the chip of the silicon which a workpiece generates by cutting with silicon when pH of cutting fluid is high mixes in cutting fluid, a with a pH of eight or less object is suitable for it. Moreover, the low thing of fizz is good. If the rusr-proofer which blended the carboxylic acid is used, since pH change of the cutting fluid at the time of cutting can be adjusted to eight or less pH, the above-mentioned gelation can be prevented and it is suitable. Since the rust-proofing effectiveness will fall and few additions of a rusr-proofer will serve as many cost quantities if there are, 0.25 - 0.5 % of the weight is suitable for them.

[0029] ** A defoaming agent is harmless to the body, its safety is high, and it is desirable that thermal resistance uses a good food-grade defoaming agent. As a food-grade defoaming agent, although there are fatty-acid-ester systems (glycerine fatty acid ester etc.) and silicone systems (silicone oil etc.), a food-grade silicone defoaming agent is suitable also in it. Since a food-grade silicone defoaming agent has the strong defoaming effectiveness, it has effectiveness sufficient by addition of ultralow volume. Moreover, compared with other defoaming agents, it is durable. Since the adhesion to a cutting member will worsen if there are many additions of a defoaming agent, 0.1 - 0.5 % of the weight is optimum dose.

[0030] The engine performance of an example in which the compounding ratio of each additive was hereafter changed about the aquosity cutting fluid concerning this invention is conventionally compared with the engine performance of the oily cutting fluid of elegance.

[0031] As the aquosity cutting fluid of the 1st example is shown in the upper case of the after-mentioned table 1 Sucrose fatty acid ester as a low HLB type food-grade emulsifier (HLB=5) : as a high HLB type food-grade emulsifier 1.8% of the weight ** polyglyceryl fatty acid ester (HLB=16) : the CMC:0.9% of the weight as a food-grade thickener 0.9% of the weight to water-solution 162L which mixed the glycerol:8.7 % of the weight as a food-grade wetting agent, and distilled water:87.7 % of the weight Abrasive grain (GC#800): Add 160kg, defoaming agent:0.9L, and rusr-proofer:1.8L.

[0032] As the aquosity cutting fluid of the 2nd example is shown in the lower berth of the after-mentioned table 1 Polyglyceryl fatty acid ester as a low HLB type food-grade emulsifier (HLB=7) : as a high HLB type food-grade emulsifier 0.08% of the weight ** polyglyceryl fatty acid ester (HLB=15) : the CMC:1.48% of the weight as a food-grade thickener 0.04% of the weight to water-solution 162L which mixed the glycerol:16.4 % of the weight as a food-grade wetting agent, and distilled water:82.0 % of the weight Abrasive grain (GC#800): Add 160kg, defoaming agent:0.9L, and rusr-proofer:1.8L.

[0033] As the water solution of the 3rd example is shown in the upper case of the after-mentioned table 2 Polyglyceryl fatty acid ester as a low HLB type food-grade emulsifier

(HLB=7) : as a high HLB type food-grade emulsifier 2.71% of the weight ** polyglyceryl fatty acid ester (HLB=15) : as a food-grade thickener 0.27% of the weight ** CMC: The glycerol:20.05 % of the weight as a 1.09 % of the weight and food-grade wetting agent, D sorbitol liquid:21.68 % of the weight, distilled water : to water-solution 162L which mixed 54.2 % of the weight Abrasive grain (GC#800): Add 160kg, defoaming agent:0.9L, and rusr-proofer:1.8L.

[0034] In addition, it is oily cutting fluid of the conventional example which is shown in the lower berth of the after-mentioned table 2, and it adds 180kg of abrasive grains to wrapping oil 140L.

[0035] The numeric value of each column of the viscosity of each example, pH, surface tension, and a consistency is an actual measurement among Table 1 and Table 2, respectively. In addition, about other columns, it evaluated as follows.

[0036] The column of a "bubble" is the measured value which the 100mL sample bottle was made to carry out human power rocking of the liquid which carried out 80mL extent impregnation for 1 minute, and measured the height of the bubble after neglect for 15 minutes. Moreover, liquid was measured in the condition of not putting in an abrasive grain.

[0037] The column of "abrasive grain dispersibility" is the evaluation which checked the condition of the abrasive grain which sedimented, after leaving the liquid which carried out 80mL extent impregnation into a 100mL sample bottle for 24 hours. In addition, O and the thing solidified for a while were made into **, and the valuation basis made x what is solidified for what is not solidified.

[0038] The column of "moisture evaporation" puts the cutting fluid of 30mL into a petri dish, and heats it 50 degrees C with humidistat for 4 hours, all the weight differences heating before and after heating assume that it is moisture evaporation, and the numeric value which computed the moisture boil off rate (%) from the following formula is shown. In addition, the cutting fluid into which the abrasive grain was put performed this trial.

Moisture boil-off-rate (%) = {(heating Saki [Shigekazu]-heating Shigekazu Ushiro) /heating Saki [Shigekazu]} x100 [0039] About cutting fluid, a quantum (2mL extent), the column of a "wafer desiccation simulation" is the evaluation which inspected the dryness of the cutting fluid adhering to a wafer visually at the wafer after a slice, after heating for 4 hours with the humidistat maintained at 50 degrees C after blowing. In addition, O and the thing dried for a while were made into **, and the valuation basis made the dry thing x for what is not being dried.

[0040] The column of "detergency" is the evaluation which checked whether a stream would wash the wafer heated by the wafer desiccation simulation test, and it could be washed easily. In addition, the valuation basis made O what can be washed out easily,

and made x what cannot be washed out.
[0041] The column of "the variation in wafer thickness" is the measured value which measured the variation in the thickness of each silicon wafer obtained as a result of cutting a silicon ingot with the system.
[0042] Moreover, height and width of face cut the silicon ingot of the rectangular parallelepiped whose die length is 300mm to four-place coincidence using a wire saw by 150mm, respectively, and the contents of a trial of a system cut cut down a wafer with a thickness of 0.355mm.
[0043] In this case, the wire size of the wire used for a wire saw may be 0.18mm. Moreover, as slice conditions, a wire feed rate is made into 600 m/min, a wire tension is set to 25 Ns, and a work-piece feed rate is made into 0.33 mm/min.
[0044] According to the above-mentioned test result, each example of the aquosity cutting fluid which requires for this invention the case where an oily cutting fluid is used for dispersion in wafer thickness, to being 35 micrometers or less is equipped with 30 micrometers or less and the engine performance more than abbreviation comparable. Moreover, each example of the aquosity cutting fluid concerning this invention is superior to the oily cutting fluid in detergency and a wafer desiccation simulation, and is equipped with an oily cutting fluid and the engine performance more than comparable also in the dispersibility of an abrasive grain.
[0045] In addition, in Table 1 and Table 2, it is shown that the notation of ND does not have data about the column concerned.
[0046] Since the cutting fluid with which the danger of ignition from it being aquosity does not have aquosity cutting fluid concerning this invention, either, and it adhered to the workpiece after processing can also be washed with water easily, it is more useful than an oily cutting fluid. Moreover, since the aquosity cutting fluid concerning this invention is using the food additive as the principal component, if Ushiro's cutting fluid used for cutting of a workpiece collects the abrasive grain in cutting fluid, and the chips of a workpiece, the processing as common wastewater will be possible for it at established facilities for drainage, and most problems of abandonment processing of it will be lost.
[0047] As mentioned above, although the aquosity cutting fluid concerning the operation gestalt of this invention was explained, the aquosity cutting fluid concerning this invention is not limited to the above-mentioned thing, for example, various modification is possible for it about selection of each additive, or its compounding ratio.
[0048]
[Table 1]

実施例	配合比	測定結果									実機カット結果
		粘度(25℃)(cp)	pH	表面張力(dyne/cm)	密度(kg/L)	泡(mm)	砥粒分散性	水分蒸発(%)	ウエハー乾燥模擬	洗浄性	ウエハー厚さバラツキ(μm)
1	ショ糖脂肪酸エステル :1.8wt% (HLB:5) ポリグリセリン脂肪酸エステル :0.9wt% (HLB:16) CMC :0.9wt% グリセリン :8.7wt% 蒸留水 :87.7wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	90	8.2	31.5	1.54	12	○	ND	ND	ND	ND
2	ポリグリセリン脂肪酸エステル :0.08wt% (HLB:7) ポリグリセリン脂肪酸エステル :0.04wt% (HLB:15) CMC :1.48wt% グリセリン :16.4wt% 蒸留水 :82.0wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	160	8.3	28.3	1.55	3	△	27	△	○	30μm以下

[0049]
[Table 2]

実施例	配合比	測定結果									実機カット結果
		粘度(25℃)(cp)	pH	表面張力(dyne/cm)	密度(kg/L)	泡(mm)	砥粒分散性	水分蒸発(%)	ウエハー乾燥模擬	洗浄性	ウエハー厚さバラツキ(μm)
3	ポリグリセリン脂肪酸エステル :2.71wt% (HLB:7) ポリグリセリン脂肪酸エステル :0.27wt% (HLB:15) CMC :1.09wt% グリセリン :20.05wt% D-ソルビトール液 :21.68wt% 蒸留水 :54.2wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	360	7.5	27.2	1.59	1	○	25	○	○	30μm以下
従来	ラッピングオイル 140L 砥粒(GC#800) 180kg	80	—	26.3	1.5	ND	△	—	○	×	35μm以下

[0050]
[Effect of the Invention] Since the aquosity cutting fluid concerning this invention made the aquosity liquid containing the adjuvant which is mainly concerned with a food-grade emulsifier and a food additive distribute an abrasive grain, it does not have danger, such

as ignition. Moreover, since a food emulsifier and an adjuvant make a food additive a subject, there is neither an offensive odor nor a bad influence to the body, and if separation removal of an abrasive grain and the chip is carried out also about the processing after use, processing as common wastewater can be performed easily.
[0051] Since said adjuvants are a thickener, a wetting agent, a defoaming agent, and a rusr-proofer, a thickener stabilizes distribution of an abrasive grain and makes sedimentation of an abrasive grain prevent. Moreover, a wetting agent is effective in preventing moisture evaporation. Moreover, a defoaming agent has the effectiveness which improves adhesion to cutting members, such as a wire in a wire saw. Moreover, a rusr-proofer can expect the rust-proofing effectiveness of the processing side of a workpiece.
[0052] Moreover, that whose pH of aquosity cutting fluid is 7-8 can prevent gelation of cutting fluid, even when cutting fluid-ed is silicon, and the chip of silicon mixes.
[0053] The aquosity cutting fluid which contains two or more sorts of food-grade emulsifiers with which the values of HLB differ as said food-grade emulsifier can expect improvement in lubricity and the antioxidizing effectiveness by oleophilic [of a low HLB type food-grade emulsifier]. A high HLB type food-grade emulsifier also has the operation which has the work which helps emulsification distribution of a low HLB type food-grade emulsifier, and raises the permeability of the cutting fluid to the cutting part by surface tension fall.
[0054] Moreover, since CMC is stable in a chemical, heat, and light and the thickening effectiveness is also large, a thickening operation and an emulsification distribution operation are stabilized, are demonstrated, and distributed stability and sedimentation prevention of the abrasive grain suspended in cutting fluid can expect more the aquosity cutting fluid for which the sodium carboxymethyl cellulose (CMC) is used as a food-grade thickener.
[0055] Moreover, moistness with the more expensive aquosity cutting fluid with which the glycerol for food additives is used as a food-grade moisturizer is acquired. Moreover, D sorbitol liquid reacts with a metal ion, and since the aquosity cutting fluid with which D-Sol Beetle liquid is used as a food-grade moisturizer has the function to make a chelate, it is effective in preventing oxidation by the metal ion.
[0056] Moreover, since pH is adjusted to 7-8 by the carboxylic acid even if the chip of silicon mixes in cutting fluid the aquosity cutting fluid which is the rusr-proofer with which the rusr-proofer blended the carboxylic acid, when a workpiece is silicon, gelation of cutting fluid is prevented.
[0057] Moreover, as a defoaming agent, since food-grade silicone has the strong defoaming effectiveness compared with other defoaming agents, the aquosity cutting fluid with which the food-grade silicone defoaming agent is used has few additions, and

ends.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the aquosity cutting fluid used in processing equipments, such as a wire saw.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] There is a wire saw as processing equipment which cuts the work piece which consists of hard and brittle materials, such as a silicon ingot for semi-conductors, a ceramic, and glass. This wire saw cuts a work piece by scouring of an abrasive grain, forcing on a work piece the wire of the a large number book stretched by the predetermined tension, and carrying out both-way operation of these wires.
[0003] Although the abrasive grain used at the time of cutting by this wire saw may fix on a wire (bonded abrasive method), the cutting fluid which made liquid distribute an abrasive grain is used for it in many cases (loose grain method). By this loose grain method, Ushiro's cutting fluid which the oily cutting fluid which mainly uses straight mineral oil as a principal component was used for the cutting fluid which suspends an abrasive material, and was usually used for cutting of a non-processed object from the point of being easy to adjust a fluidity is processed as industrial waste. Moreover, the penetrant remover of an organic solvent system is used as an object for washing of the workpiece after cutting processing.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the aquosity cutting fluid concerning this invention made the aquosity liquid containing the adjuvant which is mainly concerned with a food-grade emulsifier and a food additive distribute an abrasive grain, it does not have danger, such as ignition. Moreover, since a food emulsifier and an adjuvant make a food additive a subject, there is neither an offensive odor nor a bad influence to the body, and if separation removal of an abrasive grain and the chip is carried out also about the processing after use, processing as common wastewater can be performed easily.
[0051] Since said adjuvants are a thickener, a wetting agent, a defoaming agent, and a rusr-proofer, a thickener stabilizes distribution of an abrasive grain and makes sedimentation of an abrasive grain prevent. Moreover, a wetting agent is effective in preventing moisture evaporation. Moreover, a defoaming agent has the effectiveness which improves adhesion to cutting members, such as a wire in a wire saw. Moreover, a rusr-proofer can expect the rust-proofing effectiveness of the processing side of a workpiece.
[0052] Moreover, that whose pH of aquosity cutting fluid is 7-8 can prevent gelation of cutting fluid, even when cutting fluid-ed is silicon, and the chip of silicon mixes.
[0053] The aquosity cutting fluid which contains two or more sorts of food-grade emulsifiers with which the values of HLB differ as said food-grade emulsifier can expect improvement in lubricity and the antioxidizing effectiveness by oleophilic [of a low HLB type food-grade emulsifier]. A high HLB type food-grade emulsifier also has the operation which has the work which helps emulsification distribution of a low HLB type food-grade emulsifier, and raises the permeability of the cutting fluid to the cutting part by surface tension fall.
[0054] Moreover, since CMC is stable in a chemical, heat, and light and the thickening effectiveness is also large, a thickening operation and an emulsification distribution operation are stabilized, are demonstrated, and distributed stability and sedimentation

prevention of the abrasive grain suspended in cutting fluid can expect more the aquosity cutting fluid for which the sodium carboxymethyl cellulose (CMC) is used as a food-grade thickener.

[0055] Moreover, moistness with the more expensive aquosity cutting fluid with which the glycerol for food additives is used as a food-grade moisturizer is acquired. Moreover, D sorbitol liquid reacts with a metal ion, and since the aquosity cutting fluid with which D-Sol Beetle liquid is used as a food-grade moisturizer has the function to make a chelate, it is effective in preventing oxidation by the metal ion.

[0056] Moreover, since pH is adjusted to 7-8 by the carboxylic acid even if the chip of silicon mixes in cutting fluid the aquosity cutting fluid which is the rusr-proofer with which the rusr-proofer blended the carboxylic acid, when a workpiece is silicon, gelation of cutting fluid is prevented.

[0057] Moreover, as a defoaming agent, since food-grade silicone has the strong defoaming effectiveness compared with other defoaming agents, the aquosity cutting fluid with which the food-grade silicone defoaming agent is used has few additions, and ends.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Oily cutting fluid and the cleaning agent of an organic solvent system have troublesome disposal. Moreover, it cannot be said that oily cutting fluid does not have the possibility of ignition since the principal component of cutting fluid is straight mineral oil. Moreover, the dirt of the processing equipment by the cutting fluid which dispersed during cutting is intense, and we adhere to the offensive odor and the direct skin by the oil mist, or are [Yumi's etc. symptom] anxious about the bad influence to the bodies, such as a cause. Moreover, although the penetrant remover of a workpiece also used the thing of an organic solvent system, since it became the cause of main of air pollution, there was a problem that use regulation was being made.
[0005] Then, processing as common wastewater is possible, and this invention aims at offering the inconvenient aquosity cutting fluid which was mentioned above and which is not.

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MEANS

[Means for Solving the Problem] The aquosity cutting fluid concerning this invention makes the aquosity liquid containing the adjuvant which is mainly concerned with a food-grade emulsifier and a food additive distribute an abrasive grain. Adjuvants are a thickener, a wetting agent, a defoaming agent, and a rusr-proofer, and make a food additive a subject. Moreover, in order to make it possible to process as common wastewater, and in order to prevent gelation when a cut object is silicon, as for aquosity cutting fluid, it is desirable that pH is 7-8.

[0007] Moreover, as a food-grade emulsifier, there are a glycerine fatty acid ester, sucrose fatty acid ester, propylene glycol fatty acid ester, and lecithin. The polyglyceryl fatty acid ester which was excellent in thermal resistance, acid resistance, and the salt atmosphere also in it is suitable. Moreover, it is suitable for a food-grade emulsifier to contain two or more sorts of food-grade emulsifiers with which the values of HLB differ.

[0008] Moreover, as a thickener, although there are animal thickeners (casein, gelatin, gluten, etc.), vegetable thickeners (sodium alginate, xanthan gum, tamarind gum, etc.), acrylic-acid system thickeners (sodium polyacrylate etc.), and fibrin derivatives (sodium carboxymethyl cellulose (henceforth "CMC"), methyl cellulose, etc.), also in it, it is stable in a chemical, heat, and light, and CMC with the large thickening effectiveness is suitable for it.

[0009] Moreover, as a moisturizer, although there are a glycerol, propylene glycol, sodium lactate, a sorbitol, xylitol, and reduction amylolysis objects (restoration water candy etc.), the glycerol for food additives and D sorbitol liquid which were excellent in moistness also in it are suitable.

[0010] Moreover, as for a rusr-proofer, what blended the carboxylic acid is desirable.

[0011] Moreover, as a defoaming agent, although there are fatty-acid-ester systems (glycerine fatty acid ester etc.) and silicone systems (silicone oil etc.), a food-grade silicone defoaming agent is suitable also in it.

[0012]
[Embodiment of the Invention] Hereafter, the operation gestalt of the aquosity cutting fluid concerning this invention is explained. In addition, although the following operation gestalten explain the case where it applies to the processing equipment by the loose grain method, for example, a wire saw, the aquosity cutting fluid concerning this invention can be applied to other processing equipments, such as wrapping equipment and polishing equipment, for example, without being limited to wire saws.
[0013] The aquosity cutting fluid concerning this operation gestalt considers the thing which made the aquosity liquid which made distilled water, ion exchange water, etc. contain a food-grade emulsifier as base resin distribute an abrasive grain as a basic configuration. Moreover, aquosity cutting fluid is making the thickener, the wetting agent, the defoaming agent, and the rusr-proofer contain as an adjuvant.
[0014] Since the aquosity liquid which made food additives, such as a food-grade emulsifier, add is used for this aquosity cutting fluid, it can be processed as common wastewater. Moreover, it is aquosity, and since the inflammable matter is not contained, there is no fear, such as ignition. Moreover, since the aquosity liquid which made the harmless food additive contain is used, there is almost no bad influence to the body etc. Moreover, since it is aquosity, also when it adheres to processing equipments, such as adhesion on clothes, and a wire, it can wash out easily, and recycle of an abrasive grain is also easy.
[0015] Hereafter, each additive of ** food-grade emulsifier which aquosity cutting fluid makes contain, ** thickener, ** wetting agent, ** rusr-proofer, and ** defoaming agent is explained in full detail.
[0016] ** A food-grade emulsifier is an emulsifier of the usual food grade. As a food-grade emulsifier used here, there are a glycerine fatty acid ester, sucrose fatty acid ester, propylene glycol fatty acid ester, and lecithin. The polyglyceryl fatty acid ester which was excellent in thermal resistance, acid resistance, and the salt atmosphere also in it is suitable.
[0017] As for a food-grade emulsifier, it is desirable to use two kinds of things from which HLB is different. Here, "HLB" is the hydrophilic property which outlines Hydrophile Lyophile Balance and is included in a molecule, and the indexical numeric value which used oleophilic balance as a characteristic value. That is, it is a hydrophilic property, so that HLB is high, and it is oleophilic, so that HLB is low.
[0018] Since a low HLB type food-grade emulsifier is more strongly equipped with an oleophilic property, it forms the interface film in a workpiece, and it has the work which secures the lubricity of a workpiece and a cutting member (for example, wire in a wire saw). Moreover, the interface film also performs antioxidizing of a workpiece. The one where a low HLB value is lower is oleophilic more, a low HLB type food-grade

emulsifier can expect improvement in lubricity and the antioxidizing effectiveness, and that especially whose HLB values are 1-8 is suitable for it.
[0019] A high HLB type food-grade emulsifier has the work which helps emulsification distribution of a low HLB food-grade emulsifier. Moreover, there is also work of the improvement in liquid permeability to the cutting part by surface tension fall. The thing whose one where an HLB value is higher is a hydrophilic property more and especially whose HLB values are 11-16 since surface tension fall ability becomes high is suitable for a high HLB type food-grade emulsifier.
[0020] Although many additions of a low HLB type food-grade emulsifier are so good that there are, since they serve as cost quantity, 0.1 - 3.0 % of the weight is optimum dose. Since too many additions of a high HLB type food-grade emulsifier will cause foaming if there are, it is good at the little possible addition, and 0.05 - 1.50 % of the weight is optimum dose.
[0021] Both a high HLB type food-grade emulsifier and a low HLB type food-grade emulsifier have surface tension fall ability, and spasm **** of the wires by the surface tension of cutting fluid can be prevented. Moreover, when both a high HLB type food-grade emulsifier and a low HLB type food-grade emulsifier can perform reforming on the front face of abrasives suspended in cutting fluid and it is added to high concentration, there is also work as a dispersant.
[0022] ** A harmless food-grade thickener is physiologically used for a thickener. As a food-grade thickener, although there are animal thickeners (casein, gelatin, gluten, etc.), vegetable thickeners (sodium alginate, xanthan gum, tamarind gum, etc.), acrylic-acid system thickeners (sodium polyacrylate etc.), and fibrin derivatives (CMC, methyl cellulose, etc.), also in it, it is stable in a chemical, heat, and light, and CMC with the large thickening effectiveness is suitable for it.
[0023] CMC can perform distributed stability and sedimentation prevention of the abrasives suspended in cutting fluid according to a thickening operation and an emulsification distribution operation.
[0024] By the mechanical damage in the local high temperature and the local cutting section which are generated at the time of cutting, a thickener has the inclination for viscosity to fall very slightly, and can mitigate thickening of the cutting fluid by chip mixing which this generates at the time of cutting.
[0025] ** Food-grade moisturization material with a wetting agent harmless to the body is used. As a food-grade moisturizer, although there are a glycerol, propylene glycol, sodium lactate, a sorbitol, xylitol, and reduction amylolysis objects (restoration water candy etc.), the glycerol for food additives and D sorbitol liquid which were excellent in moistness also in it are suitable.
[0026] Although improvement in the amount of cutting on a moisturization disposition is

achieved by increasing the addition of the glycerol for food additives, since a cutting load becomes high, 10 - 30 % of the weight is suitable.
[0027] When an addition is 10 or less % of the weight, since the moisture antiflashing effectiveness gets extremely bad, 10 - 30 % of the weight is suitable for D sorbitol liquid.

[0028] ** Since a chemical reaction arises and cutting fluid may gel a rusr-proofer if the chip of the silicon which a workpiece generates by cutting with silicon when pH of cutting fluid is high mixes in cutting fluid, a with a pH of eight or less object is suitable for it. Moreover, the low thing of fizz is good. If the rusr-proofer which blended the carboxylic acid is used, since pH change of the cutting fluid at the time of cutting can be adjusted to eight or less pH, the above-mentioned gelation can be prevented and it is suitable. Since the rust-proofing effectiveness will fall and few additions of a rusr-proofer will serve as many cost quantities if there are, 0.25 - 0.5 % of the weight is suitable for them.
[0029] ** A defoaming agent is harmless to the body, its safety is high, and it is desirable that thermal resistance uses a good food-grade defoaming agent. As a food-grade defoaming agent, although there are fatty-acid-ester systems (glycerine fatty acid ester etc.) and silicone systems (silicone oil etc.), a food-grade silicone defoaming agent is suitable also in it. Since a food-grade silicone defoaming agent has the strong defoaming effectiveness, it has effectiveness sufficient by addition of ultralow volume. Moreover, compared with other defoaming agents, it is durable. Since the adhesion to a cutting member will worsen if there are many additions of a defoaming agent, 0.1 - 0.5 % of the weight is optimum dose.
[0030] The engine performance of an example in which the compounding ratio of each additive was hereafter changed about the aquosity cutting fluid concerning this invention is conventionally compared with the engine performance of the oily cutting fluid of elegance.
[0031] As the aquosity cutting fluid of the 1st example is shown in the upper case of the after-mentioned table 1 Sucrose fatty acid ester as a low HLB type food-grade emulsifier (HLB=5) : as a high HLB type food-grade emulsifier 1.8% of the weight ** polyglyceryl fatty acid ester (HLB=16) : the CMC:0.9% of the weight as a food-grade thickener 0.9% of the weight to water-solution 162L which mixed the glycerol:8.7 % of the weight as a food-grade wetting agent, and distilled water:87.7 % of the weight Abrasive grain (GC#800): Add 160kg, defoaming agent:0.9L, and rusr-proofer:1.8L.
[0032] As the aquosity cutting fluid of the 2nd example is shown in the lower berth of the after-mentioned table 1 Polyglyceryl fatty acid ester as a low HLB type food-grade emulsifier (HLB=7) : as a high HLB type food-grade emulsifier 0.08% of the weight ** polyglyceryl fatty acid ester (HLB=15) : the CMC:1.48% of the weight as a food-grade

thickener 0.04% of the weight to water-solution 162L which mixed the glycerol:16.4 % of the weight as a food-grade wetting agent, and distilled water:82.0 % of the weight Abrasive grain (GC#800): Add 160kg, defoaming agent:0.9L, and rusr-proofer:1.8L.
[0033] As the water solution of the 3rd example is shown in the upper case of the after-mentioned table 2 Polyglyceryl fatty acid ester as a low HLB type food-grade emulsifier (HLB=7) : as a high HLB type food-grade emulsifier 2.71% of the weight ** polyglyceryl fatty acid ester (HLB=15) : as a food-grade thickener 0.27% of the weight ** CMC: The glycerol:20.05 % of the weight as a 1.09 % of the weight and food-grade wetting agent, D sorbitol liquid:21.68 % of the weight, distilled water : to water-solution 162L which mixed 54.2 % of the weight Abrasive grain (GC#800): Add 160kg, defoaming agent:0.9L, and rusr-proofer:1.8L.
[0034] In addition, it is oily cutting fluid of the conventional example which is shown in the lower berth of the after-mentioned table 2, and it adds 180kg of abrasive grains to wrapping oil 140L.
[0035] The numeric value of each column of the viscosity of each example, pH, surface tension, and a consistency is an actual measurement among Table 1 and Table 2, respectively. In addition, about other columns, it evaluated as follows.
[0036] The column of a "bubble" is the measured value which the 100mL sample bottle was made to carry out human power rocking of the liquid which carried out 80mL extent impregnation for 1 minute, and measured the height of the bubble after neglect for 15 minutes. Moreover, liquid was measured in the condition of not putting in an abrasive grain.
[0037] The column of "abrasive grain dispersibility" is the evaluation which checked the condition of the abrasive grain which sedimented, after leaving the liquid which carried out 80mL extent impregnation into a 100mL sample bottle for 24 hours. In addition, O and the thing solidified for a while were made into **, and the valuation basis made x what is solidified for what is not solidified.
[0038] The column of "moisture evaporation" puts the cutting fluid of 30mL into a petri dish, and heats it 50 degrees C with humidistat for 4 hours, all the weight differences heating before and after heating assume that it is moisture evaporation, and the numeric value which computed the moisture boil off rate (%) from the following formula is shown. In addition, the cutting fluid into which the abrasive grain was put performed this trial.
Moisture boil-off-rate (%) = {(heating Saki [Shigekazu]-heating Shigekazu Ushiro) /heating Saki [Shigekazu]} x100 [0039] About cutting fluid, a quantum (2mL extent), the column of a "wafer desiccation simulation" is the evaluation which inspected the dryness of the cutting fluid adhering to a wafer visually at the wafer after a slice, after heating for 4 hours with the humidistat maintained at 50 degrees C after blowing. In

addition, O and the thing d[redacted]d for a while were made into *[redacted], and the valuation basis made the dry thing x for what is not being dried.
[0040] The column of "detergency" is the evaluation which checked whether a stream would wash the wafer heated by the wafer desiccation simulation test, and it could be washed easily. In addition, the valuation basis made O what can be washed out easily, and made x what cannot be washed out.
[0041] The column of "the variation in wafer thickness" is the measured value which measured the variation in the thickness of each silicon wafer obtained as a result of cutting a silicon ingot with the system.
[0042] Moreover, height and width of face cut the silicon ingot of the rectangular parallelepiped whose die length is 300mm to four-place coincidence using a wire saw by 150mm, respectively, and the contents of a trial of a system cut cut down a wafer with a thickness of 0.355mm.
[0043] In this case, the wire size of the wire used for a wire saw may be 0.18mm. Moreover, as slice conditions, a wire feed rate is made into 600 m/min, a wire tension is set to 25 Ns, and a work-piece feed rate is made into 0.33 mm/min.
[0044] According to the above-mentioned test result, each example of the aquosity cutting fluid which requires for this invention the case where an oily cutting fluid is used for dispersion in wafer thickness, to being 35 micrometers or less is equipped with 30 micrometers or less and the engine performance more than abbreviation comparable. Moreover, each example of the aquosity cutting fluid concerning this invention is superior to the oily cutting fluid in detergency and a wafer desiccation simulation, and is equipped with an oily cutting fluid and the engine performance more than comparable also in the dispersibility of an abrasive grain.
[0045] In addition, in Table 1 and Table 2, it is shown that the notation of ND does not have data about the column concerned.
[0046] Since the cutting fluid with which the danger of ignition from it being aquosity does not have aquosity cutting fluid concerning this invention, either, and it adhered to the workpiece after processing can also be washed with water easily, it is more useful than an oily cutting fluid. Moreover, since the aquosity cutting fluid concerning this invention is using the food additive as the principal component, if Ushiro's cutting fluid used for cutting of a workpiece collects the abrasive grain in cutting fluid, and the chips of a workpiece, the processing as common wastewater will be possible for it at established facilities for drainage, and most problems of abandonment processing of it will be lost.
[0047] As mentioned above, although the aquosity cutting fluid concerning the operation gestalt of this invention was explained, the aquosity cutting fluid concerning this invention is not limited to the above-mentioned thing, for example, various modification

is possible for it about selection of each additive, or its compounding ratio.

[0048]

[Table 1]

実施例	配合比	測定結果 粘度(25℃)(cp)	pH	表面張力(dyne/cm)	密度(kg/L)	泡(mm)	砥粒分散性	水分蒸発(%)	ウエハー乾燥模様	洗浄性	実機カット結果 ウエハー厚さバラツキ(μm)
1	ショ糖脂肪酸エステル(HLB:5) :1.8wt% ポリグリセリン脂肪酸エステル(HLB:16) :0.9wt% CMC :0.9wt% グリセリン :8.7wt% 蒸留水 :87.7wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	90	8.2	31.5	1.54	12	○	ND	ND	ND	ND
2	ポリグリセリン脂肪酸エステル(HLB:7) :0.08wt% ポリグリセリン脂肪酸エステル(HLB:15) :0.04wt% CMC :1.48wt% グリセリン :16.4wt% 蒸留水 :82.0wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	160	8.3	28.3	1.55	3	△	27	△	○	30μm以下

[0049]

[Table 2]

実施例	配合比	測定結果 粘度(25℃)(cp)	pH	表面張力(dyne/cm)	密度(kg/L)	泡(mm)	砥粒分散性	水分蒸発(%)	ウエハー乾燥模様	洗浄性	実機カット結果 ウエハー厚さバラツキ(μm)
3	ポリグリセリン脂肪酸エステル(HLB:7) :2.71wt% ポリグリセリン脂肪酸エステル(HLB:15) :0.27wt% CMC :1.09wt% グリセリン :20.05wt% D-ソルビトール液 :21.68wt% 蒸留水 :54.2wt% 計 100wt% 上記の切削液 162L 砥粒(GC#800) 160kg 消泡剤 0.9L 防錆剤 1.8L	360	7.5	27.2	1.59	1	○	25	○	○	30μm以下
従来	ラッピングオイル 140L 砥粒(GC#800) 160kg	80	—	26.3	1.5	ND	△	—	○	×	35μm以下

[Translation done.]